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Out-of-Pocket Healthcare Costs and Undesirable Healthcare Expenditures

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Out-of-Pocket Healthcare Costs and Undesirable Healthcare Expenditures.

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Abstract

Healthcare costs in the U.S. have risen over recent decades, and this issue was a focal point of the last several national election cycles. I investigate the relationship between out-of-pocket healthcare costs and incidences of catastrophic and impoverishing healthcare expenditure. I also explore whether other important factors, such as demographic, personal health, and those related to the healthcare system change the likelihood of such healthcare expenditures. Lastly, I use a difference in means method and logistic regressions to analyze the probability of incurring undesirable healthcare expenses and the impacts of relevant factors for certain subsections of the U.S. population. I confirm previous findings on the effects of healthcare system utilization, health status, and socioeconomic status. Additionally, I find evidence that Africans Americans, women, the disabled, and those with chronic health conditions are disproportionately susceptible to catastrophic and impoverishing healthcare expenditures.

1.Introduction

Healthcare is a significant portion of a household's expenditure in the U.S., making up an average of 8.1 percent of household spending in 2018.[1] Healthcare prices grew at a much faster rate than inflation over the past two decades, and the share of the average household budget that is taken up by healthcare costs has steadily risen over time.[2][3] This trend of rising healthcare costs is concerning, as income that could go to other goods or saved for future consumption is increasingly used for healthcare. The two clearest ways healthcare costs negatively impact consumption is through *catastrophic healthcare expenditure* and *impoverishing healthcare expenditure*. Using both as indicators of negatively impacted consumption, I analyze these expenditures using pooled panel data in the United States to answer three central questions:

I. How prevalent is catastrophic and impoverishing healthcare expenditure in the United States?
II. What are the factors that increase and decrease the likelihood of catastrophic and impoverishing healthcare expenditure?
III. How do the incidence rates of these expenditures and their contributing factors differ between different subsections of the U.S. Population?

A healthcare system must deal with three primary issues: minimizing costs, maximizing access, and improving quality of care. This is known as the iron triangle of healthcare, and it is very hard for a healthcare system to be good in all three areas, as there are trade-offs and constraints to improving in one area.[4] Incidences of catastrophic healthcare expenditure and

[1] (Chalise 2020)
[2](Claxton et al. 2018)
[3] (Chalise 2020)
[4] Iron Triangle concept was first introduced by Professor William Kissick

impoverishing healthcare expenditure are the result of a healthcare system that has failed to contain costs and sufficiently protect an individual from healthcare expenses.[5] Both catastrophic and impoverishing healthcare expenditure have fluid and arbitrary definitions in the literature, but I define catastrophic healthcare expenditure as any expenditure that creates medical debt, and I define impoverishing healthcare expenditure as any healthcare expenditure that takes a household's income below the poverty line.

In the impoverishing case, a household's consumption is negatively impacted because health care expenses are taking up such a large portion of its budget that a household's post-healthcare expenditure income is below the poverty line. In the catastrophic case, medical debt, and the costs of servicing that debt put a constraint on an individual's and their consumption on other goods or services. Additionally, medical debt is different from other types of debt. Some debt, like student loan debt, is taken on in anticipation of higher future income. Other debt, like mortgage debt, is taken on because housing and land are assets that generally appreciate over time. Even debt like credit debit can serve a purpose, if serviced correctly, in allowing for expanded present consumption. Medical debt is often taken on for no other purpose than necessity because the cost of not paying for treatment often means death, poor health, or an inability to work in the future. Healthcare as a service is a necessary good and this is shown by the fact that "despite a wide variety of empirical methods and data sources, the demand for health care is consistently found to be price inelastic."[6] Individual and household willingness to pay for good health and to avoid death is justifiably high, sometimes so high that they will forgoe consumption on other goods and services.

[5] (Thomson, Cylus, and Evetovits 2019)
[6] (Ringel et al. 2002)

In any healthcare system, health insurance serves the purpose of protecting individuals and households from unexpected, high medical expenses. Individuals and households are collected into risk pools and pay a monthly premium to an insurance company, which then pays a significant portion of the healthcare expenses of that risk pool when they utilize the healthcare system. Despite this, individuals and households pay out of pocket for their healthcare up to their deductible threshold, when the insurance kicks in, and they pay a percentage of their expenses through copayments, coinsurance, and for any medical services not covered by insurance.

Some countries' healthcare systems have one insurer, the national government, while others have a highly regulated market of only private insurers, and some have both private and public options. Despite these differences, almost all industrialized nation's healthcare systems are universal, meaning every citizen in these countries has some level of financial protection. The United States is unique in its healthcare system, as it remains the only OCED country that has not achieved universal coverage and it has a multi-payer and a multi-layered system that is not seen anywhere else in the industrialized world.[7] Most Americans get healthcare coverage through their employer, but Americans also directly purchase insurance for themselves, and depending on whether they are poor, elderly, a Native American, or in the military, get their insurance from their state or the federal government. Despite all these avenues for coverage and financial protection, gaps in coverage in the U.S. healthcare system are widespread, as 8.6% or 28 million Americans were uninsured as of 2020.[8] These gaps occur as a result of losing one's job, being too poor to directly purchase healthcare but making just enough income to be disqualified for public coverage, or simply being underinsured, having coverage but not having enough to protect from all of one's healthcare expenses.

[7] (Tikkanen et al. 2020)
[8] (Bunch and Keisler-Starkey 2021)

2. Literature Review

Given the U.S.'s unique healthcare system and the ever-rising costs of healthcare, an analysis of catastrophic and impoverishing healthcare expenditure is a meaningful undertaking and quite a bit of previous research has focused on this link between healthcare costs and negatively impacted consumption. Kuroki (2020) studied the effect that Medicaid expansion had on Chapter 7 bankruptcy at the state and local levels. Using U.S. Census Bureau data, he found that "an increase in the share of low-income people with health insurance may have played a non-negligible role in explaining variation in Chapter 7 personal bankruptcy rates" between the years 2014 and 2018.[9] States that originally expanded Medicaid saw decreased rates of personal bankruptcy, with the increase in the share of the population insured likely accounting for more than half of the decline during the four years of interest. This effect is unsurprising as the Medicaid program offers financial protection to the most financially insecure demographic in the country, but this finding highlights the considerable magnitude of this effect on low-income individuals. I expand on this finding in two ways: first, by analyzing whether this effect holds for different indicators of consumption patterns (catastrophic and impoverishing health spending) and second, by comparing the effect size between public insurance schemes and private insurance schemes.

In a 2016 Kaiser Family Foundation and New York Times report, Hamel et al. (2016) surveyed Americans ages 18-64 on their medical expenditures and the impact those expenses had on their healthcare utilization and household budgets.[10] This double weighted probability-based sample of 2,575 Americans found that a quarter of U.S. adults either had trouble paying their

[9] (Kuroki 2021)
[10] (Hamel et al. 2016)

medical bills or couldn't pay at all. Additionally, from this data, trouble with medical bills is associated with insurance status, income level, and disability status. Lastly, of those who reported having trouble paying medical bills, 44% reported it having a major impact on their household consumption patterns, while 47% responded that it had a minor impact on their consumption. This survey and its results inform the specification of my models and the variables I include, such as disability status and measures of income and wealth.

Baird (2016) explored my main predictor variable, out of pocket healthcare expenses, in her article "High Out-of-Pocket Medical Spending among the Poor and Elderly in Nine Developed Countries." Using nationally representative household survey data she finds that the United States healthcare system is not unique in exposing many individuals to high out of pocket healthcare expenses. These expenses "can cause individuals to forgo health care", causing inequities not only in access to care, but medical outcomes.[11] Another report, by the World Health Organization, studied the impact of out-of-pocket payments for healthcare and found similar results as Baird (2016) by using national household budget survey data across 24 high- and middle-income countries in Europe. The WHO found that "catastrophic health spending is consistently heavily concentrated among the poorest fifth of the population" and that it is "mainly driven by out-of-pocket payments for outpatient medicines" where financial protection is relatively weak.[12]

Li et al. (2020) studied the "incidence and causes of medical debt in Chinese low- and middle-income households."[13] Using a very narrow definition of medical debt, how much a household borrowed to pay medical bills, Li et al. found that incidence rates of medical debt in

[11] (Baird Ph.D 2016)
[12] (Thomson, Cylus, and Evetovits 2019)
[13] (Li et al. 2020)

China were relatively low, but once medical debt occurred it forced "many low and middle-income households into poverty." Additionally, Li et al. discovered that age, education, health status of the head of the household, hospitalization, and types of medical insurance were "significant factors determining medical debt." I use a broader definition of medical debt than Li et al., but I incorporate many of their variables in my analysis of medical expenditure in the United States.

Richard, Walker, and Alexandre (2018) "examined the relationship between chronic health conditions and out-of-pocket costs and medical debt."[14] They found that households with members who have chronic health conditions have a higher likelihood of incurring medical debt and have higher odds of incurring larger amounts of medical debt. I do not attempt to predict the amounts of medical debt individuals incur, but I do incorporate the presence of chronic health conditions in my analysis. Lastly, Herman, Rissi, and Walsh (2011) studied the relationship between health insurance status and medical debt in the state of Arizona. They found no evidence that insurance status predicted medical debt "after controlling for health status, income, age, and household characteristics", however they find that being uninsured and having medical debt predict reduced utilization of the healthcare system.[15] Part of my analysis seeks to understand if this lack of effect Herman et al. found in the State of Arizona holds for the entire United States population.

3.Methods

The central goal of my research is to analyze the impact that out-of-pocket healthcare expenditure has on consumption. I measure impacts on consumption indirectly by analyzing

[14] (Richard, Walker, and Alexandre 2018)
[15] (Herman, Rissi, and Walsh 2011)

whether healthcare expenditure puts an individual in medical debt and whether healthcare expenditure brings a household's income below the poverty line. I also model the likelihood of each type of expenditure using various explanatory factors, and breakdown these expenditures by subsections of the U.S. population. To do this, I use pooled longitudinal data from the U.S. Census Bureau's Survey of Income and Program Participation (SIPP). This data consists of three nationally representative sets of panel data for the years 2017, 2018, and 2019, with each set tracking different individuals and households in the nation. The samples for each year are multistage, stratified samples of households from areas "designed to represent the civilian, noninstitutionalized population of the U.S."[16] Originally each person in the survey had 12 different observations, one for each month in the year. I created new annualized variables where appropriate to construct an annual-level sample. The final dataset over the three-year reference period has a total of 65,817 individuals.

To measure catastrophic medical expenditure, survey participants were asked a yes/no question regarding "whether any money was owed for medical bills not paid in full during the reference period?".[17] If the respondent's answer was yes than that qualified as having medical debt, which I define as an incidence of catastrophic medical expenditure. Using medical debt as the dependent variable, I created three base models estimated by logistic regression. The logistic regression model is justified because the outcome variable of interest is a categorical dependent variable with two discrete outcomes if an individual had medical debt or not. Additionally, logistic regression models are frequently utilized in past health outcomes research, especially regarding medical debt.[18] The first model has three explanatory variables: how much an

[16] (Irving and Smith 2021)
[17] (Irving and Smith 2021)
[18] (Thomson, Cylus, and Evetovits 2019) and (Richard, Walker, and Alexandre 2018) are examples of papers that use logistic regressions for their analysis

individual paid out-of-pocket for their non-premium medical expenses in the reference year, an individual's family income during the reference year, and the sum of assets an individual has, which I calculate as the total sum of money an individual had in their checking's and savings accounts during the reference year. Out-of-pocket expenditure is measured in units of thousands of dollars while annual family income and assets are measured in units of tens of thousands of dollars.

$$\textit{Model One: Log } \left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 \textit{Out-Of-Pocket Expenditure} + \beta_2 \textit{Family Income} + \beta_3 \textit{Assets} + \mu$$

From the literature on medical debt and from intuition, these three variables theoretically should explain a lot about the incidences of medical debt. One cannot go into medical debt if they don't incur any healthcare costs, and ability to pay for out-of-pocket healthcare expenses should be a function of the amount of money one's family makes in a year and the amount of money an individual has at their disposal in their bank accounts.

Model two for catastrophic healthcare expenditure accounts for factors that relate an individual to the healthcare system. Health insurance status is consistently found to be a significant factor in reducing rates of catastrophic healthcare expenditure. Because of this, I include two explanatory variables to capture insurance status: a continuous variable which measures how many months out of the year the survey respondent was insured, and a dummy variable which equals 1 if the survey respondent was uninsured for the entire reference year. Two additional insurance related dummy variables are also included, one which equals 1 if the respondent had private insurance and other which equals one if the respondent had public insurance during the reference period. I include these two variables on top of the other insurance variables because while having any insurance provides better financial protection than none, I

suspect that public insurance schemes should better protect individuals from medical debt than private schemes.

Herman et.al. (2011) found evidence in Arizona that when medical debt occurs, healthcare utilization decreases significantly, but an interesting question that flips this effect is whether increased utilization of the healthcare system increases the likelihood of medical debt. For this reason, I include two healthcare utilization explanatory variables in the second model: one which measures how many times during the reference period a respondent saw their medical provider about their health, and another which measures how many nights in the reference period a respondent spent in the hospital. The last two explanatory variables that I include in this second model are a dummy variable indicating whether the respondent is disabled, and an ordinal categorical variable which asks respondents to rate their health status on a scale of 1-5 with one being the best health and 5 being poor health. These two variables are included as proxy variables for chronic health conditions, which the body of past research has found to be a significant factor in the incidence of medical debt. When accounting for all the new variables which relate an individual to the healthcare system, the second logistic model takes the form:

$$\textit{Model 2: Log } \left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 \textit{Out-of-Pocker Expenditure} + \beta_2 \textit{Family Income} + \beta_3 \textit{Assets} + \beta_4 \textit{Months Insured} + \beta_5 \textit{Uninsured} + \beta_6 \textit{Doctor Visits} + \beta_7 \textit{Hospital Visits} + \beta_8 \textit{Disability} + \beta_9 \textit{Health Status} + \beta_{10} \textit{Private Insurance} + \beta_{11} \textit{Public Insurance} + \mu$$

The last model for catastrophic healthcare expenditure factors in other demographic information that could impact whether an individual goes into medical debt. I include educational attainment and total amount of transfer payments a respondent received from the government, because an increase in both should theoretically lower the likelihood of medical debt. Educational attainment because it correlates with higher income levels and transfer payments because they should provide an extra cushion to allow for more healthcare

consumption. Dummy variables for Women and African Americans are included because both racial and gender-based disparities have been noted in the healthcare field and these inequities sometimes materialize as added healthcare expenditure.[19] I include a citizenship dummy variable as well because it is possible that non-citizens who have less access to healthcare coverage would be paying more out-of-pocket for their healthcare. The last variable in the third model indicates if the respondent has other types of debt, specifically student loan and credit card debt, with the assumption prior debt obligations should make one more susceptible to medical debt.

Model 3: $Log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 Out\text{-}of\text{-}Pocket\ Expenditure + \beta_2 Family\ Income + \beta_3 Assets + \beta_4 Months\ Insured + \beta_5 Uninsured + \beta_6 Doctor\ Visits + \beta_7 Hospital\ Visits + \beta_8 Diability + \beta_9 Health\ Status + \beta_{10} Private\ Insurance + \beta_{11} Public\ Insurance + \beta_{12} Government\ Transfers + \beta_{13} Educational\ Attainment + \beta_{14} Citizenship + \beta_{15} African\ American + \beta_{16} Woman + \beta_{17} Debt + \mu$

To model impoverishing medical expenditure, I group the individuals in the survey together into households and create annualized variables for those households. Using two household identifying variables in the Census Bureau's survey, a total of 28,199 households were created. The Census Bureau measures whether a household is in poverty by a poverty threshold which accounts for each household's size and income, and if a household's threshold value is below 1 that household is considered impoverished. To measure impoverishing medical expenditure, I take each household's annual income, subtract the amount each household spent out-of-pocket on healthcare, and then divide that amount by that household's poverty threshold for the reference year. If the resulting number was below 1, then I designate that household as incurring impoverishing healthcare expenditure.

[19] (Owens 2008) (Turner et al. 2020)

As with catastrophic healthcare expenditure, I use the logistic regression model for impoverishing healthcare expenditure, using similar explanatory variables. Model 1 accounts for household wealth, whether a household has a member on Medicaid, Medicare, or is a privately insured household, and the average number of months a household member was insured. Model 1 for impoverishing healthcare expenditure also accounts for the total amount of times household members visited a healthcare provider, the total amount of nights household members stayed in a hospital, and whether any household member was disabled.

$$Model\ 1: Log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 Wealth + \beta_2 Medicaid\ Household + \beta_3 Medicare\ Household + \beta_4 Household\ Insurance + \beta_5 Privately\ Insured + \beta_6 Doctor\ Visits + \beta_7 Hospital\ Stays + \beta_8 Disability + \mu$$

Model 2 adds onto model 1 by accounting for educational attainment, African American households, how many women are in a household, household citizenship status, and whether a household has previous debt obligations.

$$Model\ 2: Log\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 Wealth + \beta_2 MedicaidHousehold + \beta_3 MedicareHoushold + \beta_4 HouseholdInsurance + \beta_5 PrivatelyInsured + \beta_6 DoctorVisits + \beta_7 HospitalStays + \beta_8 Disability + \beta_9 EducationalAttainment + \beta_{10} AfricanAmerican + \beta_{11} Women + \beta_{12} Citizen + \beta_{13} Debt + \mu$$

4.Results and Discussion

The first question I seek to answer is what the incidence rates of catastrophic and impoverishing health care expenditure were in the United States within the three-year reference period. **Table 1** displays rates of catastrophic healthcare expenditure during the reference period. During this time frame approximately 10% of the U.S. population incurred medical debt, which roughly translates to about 30 million instances of catastrophic healthcare expenditure. Additionally, **table 1** displays the rates of medical debt among various subsections of the U.S.

population during this period. White Americans, men, the fully insured, publicly and privately insured, and non-citizens have lower rates of catastrophic healthcare expenditure in comparison to the overall U.S. non-institutionalized population. The uninsured, women, non-white Americans, African Americans, and U.S. citizens have higher rates of catastrophic healthcare expenditure compared to the overall U.S. non-institutionalized population.

TABLE 1.

Group	Catastrophic medical expenditure rate
U.S Non-institutionalized population	**10.40%**
Subgroups:	
Fully insured	9.68%
Uninsured	15.00%
Publicly Insured	**9.82%**
-Medicare population	*9.37%*
-Medicaid population	*11.38%*
-Military coverage	*10.49%*
Disabled	15.97%
Privately Insured	**9.28%**
-Employer sponsored	*-9.59%*
-Direct purchase	*-8.61%*
-Medicare supplement	*-7.06%*
White	9.89%
Non-white	12.70%
Black	16.97%
Male	8.82%

Female	11.93%
Citizen	10.60%
Non-citizen	7.73%

From the catastrophic medical expenditure incidence rates, there are some interesting and startling findings. African Americans have the highest rates of medical debt of any subgroup, higher even than the disabled and the uninsured who themselves have higher than average rates of medical debt. Even without further analysis, this finding might indicate that there is a systematic difference in the healthcare needs of African Americans and that the U.S. healthcare system is failing to either to appropriately treat or financially protect Africans American. Another interesting finding is that non-citizens have lower rates of medical debt than citizens, which is surprising because non-citizens don't typically have the same access to healthcare insurance, and for this reason I suspected they would be paying more out-of-pocket for their healthcare.[20] The disabled and the uninsured having higher than average rates of medical debt is unsurprising as previous research has found that these groups are more susceptible to catastrophic expenditures. Nevertheless, those numbers and the overall 10% incidence rate of catastrophic healthcare expenditure are alarming findings which indicate that the non-universal and fragmented U.S. healthcare system isn't doing enough to financially protect users of its system.

While the incidence rates of catastrophic healthcare expenditure convey some important information, means comparison hypothesis tests are necessary to see if the differences in medical debt rates between these subgroups are the result of systematic differences or just occurred by

[20] (KFF 2021)

chance. I ran a total of 5 different tests comparing: the fully insured to the partially/uninsured, the privately insured to the publicly insured, white population to the minority population, women to men, and the Medicaid population to the non-Medicaid population. I pool the uninsured and partially insured groups together in the hypothesis test because very few respondents had an in-between number of months where they had insurance, the vast majority (96.3%) were either fully insured or completely uninsured during the reference period. The null hypothesis in each test is that the difference in means between groups is zero and my rejection threshold is at the 5% level. The alternative hypothesis for each test is a double-sided hypothesis that the difference in means does not equal zero.[21] Prior to each test a variance ratio test was conducted between the groups and in each instance the standard deviations between the groups were found to be unequal, so the hypothesis tests were adjusted accordingly. In each of the 5 difference-in-means hypotheses test the null hypothesis was rejected at the 1% level, confirming that the differences in catastrophic healthcare expenditure rates between these different groups likely did not occur by chance.

The summary statistics and the hypothesis tests display the rates of catastrophic healthcare expenditure and show that the difference in the rates of medical debt is the result of systematic differences between the sub-groups that I compare. However, they do not answer some questions, like the relative importance of each subgroup in modeling medical debt, and other questions like whether public insurance schemes do a better job at financial protection than private schemes. It may be true that the incidence rates of medical debt are higher percentagewise for individuals covered by public insurance programs but controlling for other factors public insurance still may be preferable from a financial protection standpoint. This is where the logistic regression models come in.

[21] H_0 = Mean of $Subgroup_i$ – Mean of $subgroup_j$ =0
H_a = Mean of $Subgroup_i \neq$ Mean of $subgroup_j$ =0

Table 2. displays the odd ratios of my three baseline models of catastrophic medical expenditure. The first model predicts approximately a 14-15% baseline probability of catastrophic healthcare expenditure and finds that an individual's likelihood of going into medical debt increases by 1.4% for every 1000 dollars they spend out-of-pocket on healthcare. Additionally, the model finds that for every additionally $10,000 an individual's family has in income, or an individual has in assets, the risk of catastrophic medical expenditure declines by 6.4% and 2.5% respectively. Each predicted effect is statistically significant at the 0.1% level, and this first model has a pseudo R^2 of 2.96%. None of these findings are particularly surprising given the literature and the nature of health care spending. Income and available assets directly correspond to a person's ability to pay their medical bills, and intuitively, the more one must spend out-of-pocket the more likely they are to not going to be able pay to afford their medical bills.

The third column of **table 2** displays the odds ratios of the second logistic regression, which incorporates factors that relate an individual to the healthcare system, including utilization, insurance coverage, and health status variables. The second model predicted a 17%-18% baseline odds of medical debt and finds a slight decrease in the impact that out-of-pocket expenditure, annual family income, and individual assets have on medical debt likelihood. Additionally, an extra month of insurance coverage is associated with an 8.0% reduction in likelihood and being completely uninsured throughout the year is associated with a 65.3% reduction in likelihood of medical debt. An additional visit to one's healthcare provider and an additional night in the hospital is associated with a 0.8% and 1.0% increase in likelihood respectively. Being disabled and a decrease in health status is associated with a 62.1% and a 47.7% increase of likelihood respectively. Lastly, all factors held constant, the second model

predicts that on average, public health insurance coverage reduces the likelihood of catastrophic medical expenditure by 60.1%, while private health insurance coverage only reduces this risk by 26.3%. As with model 1, all of model 2's estimated impacts are statistically significant at the 0.1% level, while model 2's pseudo R^2 improves to 8.49%.

Model 2 confirms a lot of what the previous literature already discovered, which is that increased utilization, the presence of a disability or a chronic condition, and not having health insurance coverage increases the likelihood of incurring catastrophic healthcare expenditures. A very surprising finding is that being uninsured significantly lowers one's likelihood of incurring medical debt, especially considering the uninsured population has one of the highest rates of catastrophic healthcare expenditure. A possible explanation for this which has been shown in the literature is that while the uninsured utilize the healthcare system much less than they would if they had insurance, when they do utilize the healthcare system, they are much more exposed to the costs of healthcare.

Another thing that my 2nd model finds is that having public insurance reduces the risk of medical debt significantly and does so even more than having private insurance. I hypothesized that controlling for other factors public insurance schemes had better financial protection than private insurance, despite having higher incidence rates of medical debt. A possible reason for this is that public insurance schemes are means tested, as the populations they serve are chosen for a specific reason. Medicaid and Medicare both serve vulnerable populations, the poor and the elderly, who without insurance would find it nearly impossible to pay their medical bills. The poor have limited disposable income and the elderly Medicare population are on fixed incomes and are likely to need to utilize the healthcare system more often. Given these characteristics, Medicaid and Medicare may have lower cost sharing requirements than private insurance, which

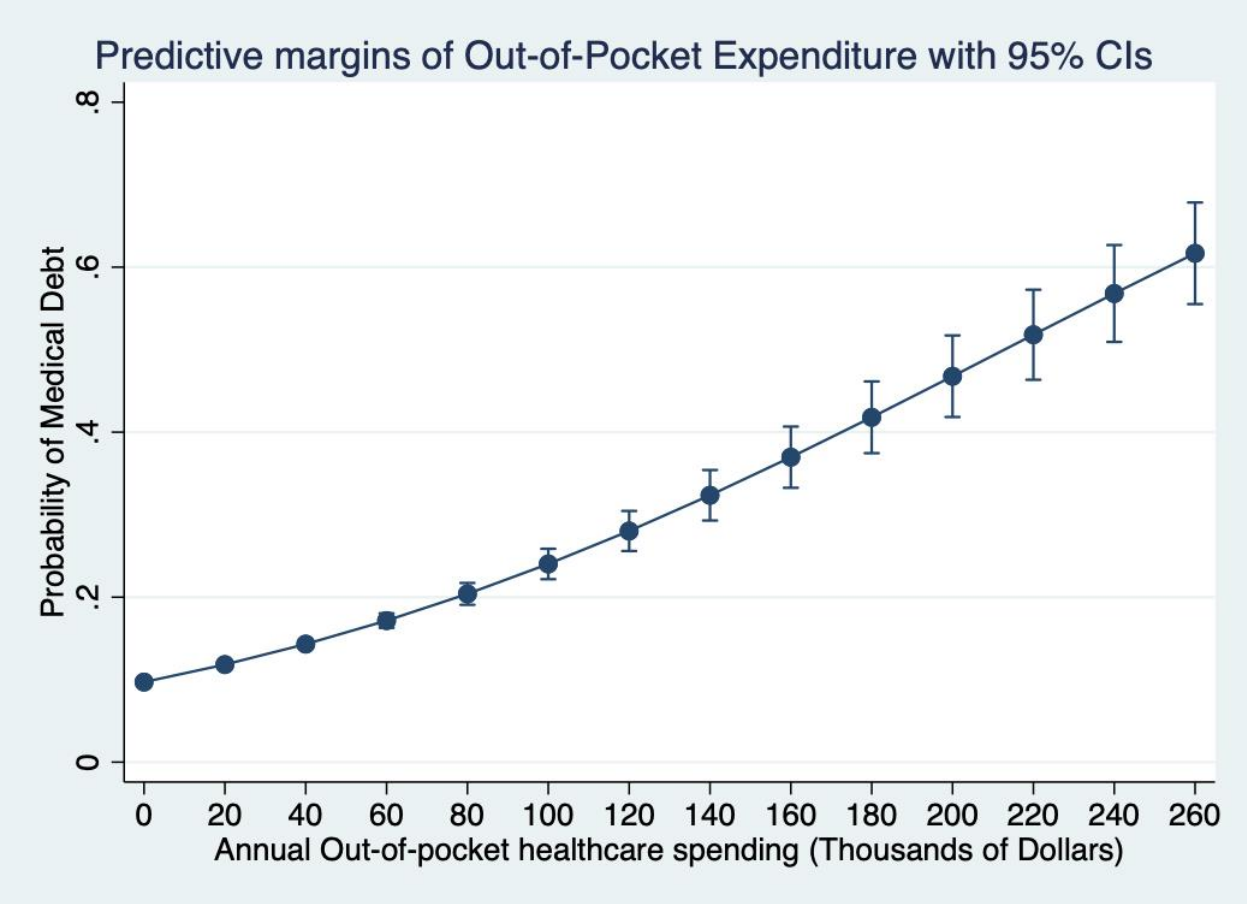
would lower the likelihood of incurring medical debt. Additionally, active-duty personnel who get their insurance through the government "have less discretion in seeking care than their civilian counterparts" and "they are provided more frequent preventive and routine care than would be typical for civilians the same age".[22] Service members are provided more up-front healthcare to catch issues before they develop into bigger problems, and service members are likely to be healthier than the general population which may explain why all else equal, having public insurance is preferable from a financial protection standpoint.

The last column of **table 2** displays the results of model 3, which accounts for other demographic information. An additional $1000 dollars in governments transfer payments is associated with a decrease in the likelihood of medical debt of 14.2%, a unit increase in educational attainment decreases likelihood by 8.8%, and being a woman increases likelihood by 29.8%. Being an African American increased likelihood by 65.9% and being a citizen increased likelihood by 39.7%. The direction of the effect of the debt variable is unsurprising but the magnitude of it is, as having credit card or student loan debt is associated with 302% increase in likelihood of having medical debt. The third model predicts a baseline probability of medical debt of 8.3% and like the other two models, all estimated odds ratios were found to be highly statistically significant at the 0.1% level. Model 3 accounts for 17 highly statistically significant explanatory variables and has an improved pseudo R^2 of 13.04%. **Figure 1.** Graphically displays the estimated impact that my main predictor variable, out-of-pocket expenditure, has on the probability of incurring medical debt. **Figures 2** and **3** in the appendix display the relationships between my model's two utilization variables, doctor visits and hospital stays, and the probability of catastrophic healthcare expenditure.

[22](Ringel et al. 2002)

Catastrophic Healthcare Expenditure	***Model 1*** *(Pseudo R^2= 2.94%)*	***Model2*** *(Pseudo R^2= 8.49%)*	***Model3*** *(Pseudo R^2=13.04%)*
Annual Out-of-Pocket Expenditure	1.014*** (23.65)	1.013*** (20.17)	1.013*** (19.47)
Annual Family Income	0.936*** (-19.29)	0.951*** (-14.42)	0.957*** (-12.48)
Assets	0.975*** (-9.59)	0.980*** (-8.30)	0.983*** (-6.96)
Yearly Insurance		0.920*** (-7.90)	0.913*** (-8.40)
Uninsured		0.347*** (-8.32)	0.396*** (-7.10)
Doctor Visits		1.008*** (8.04)	1.008*** (7.71)
Hospital Stays		1.010*** (5.66)	1.013*** (6.82)
Disability		1.621*** (13.34)	1.688*** (14.09)
Health Status		1.477*** (25.89)	1.452*** (23.97)
Public Insurance		0.399*** (-20.64)	0.525*** (-12.18)
Private Insurance		0.738*** (-6.77)	0.781*** (-5.24)
Government Transfers			0.858*** (-5.90)
Educational Attainment			0.912*** (-8.96)
Citizenship			1.397*** (4.56)
African American			1.659*** (12.58)
Woman			1.298*** (-8.61)
Debt			3.028*** (35.70)
Constant (Baseline odds)	14.7%***	17.9% ***	8.3%***
	t statistics in parentheses	* p<0.05, ** p<0.01, *** p<0.001	

Figure 1.



Transfer payments and educational attainment having the effects that they do are not surprising, however the increase in odds that being black, a woman, or being a citizen has on the likelihood of medical debt is. However, I suspect that the citizenship estimate reflects systematic differences within the non-citizen population rather than the citizen population. Noncitizens are grouped into two categories: legal and non-legal residents, and there may be a selectivity issue at play here, something noted by Feliciano (2020) when she stated that the "positive selection of immigrants can help explain some paradoxical patterns of success among immigrants… in the domains of health, labor market outcomes, and education."[23] When talking about legal non-citizens we could be selecting for wealthier and healthier individuals than that of the overall U.S.

[23](Feliciano 2020)

population. Furthermore, even if legal non-citizens are not wealthy, "lawfully present immigrants may qualify for Medicaid and CHIP" and "can purchase coverage through the ACA Marketplaces and may receive subsidies for this coverage", which provides them with the previously mentioned benefits of public insurance protection.[24] When discussing non-legal residents, we could be selecting for a younger demographic in comparison to the U.S. population and a population that utilizes the healthcare system much less on average. "Noncitizens are significantly more likely than citizens to be uninsured" and while insurance status is correlated with utilization, nonlegal residents have an added disincentive to utilize the healthcare system out of fear of being reported to law enforcement.[25]

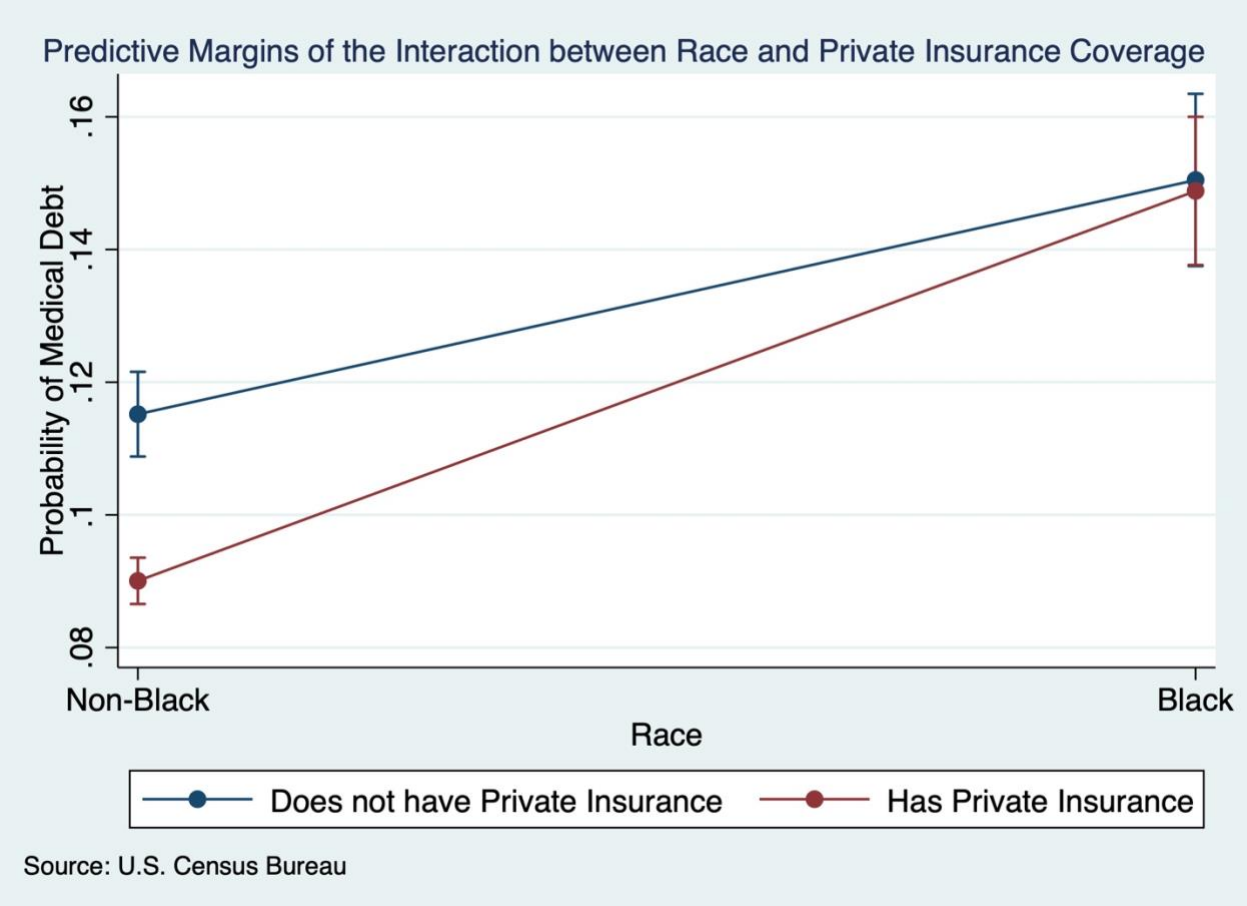
Using model 3 as a baseline model, I ran 4 additional catastrophic expenditure logistic regressions for the following subsections of the U.S. Population: women, African Americans, non-citizens, and the Medicare population. The odds ratios of these groups are displayed in **Table 3** in the Appendix. For women, the effect of factors that lessen the likelihood of medical debt for the general population were slightly reduced and factors that increased the likelihood of medical debt for the U.S. population were slightly amplified. The same trend applied to the Medicare population, but the effects of variables like citizenship and transfer payments were not found to be statistically significant and this could simply be explained by the fact that to qualify for Medicare you by default are already receiving a transfer payment and are already a citizen. Having private insurance as a Medicare recipient has a larger negative impact on the likelihood of medical debt than any other subsection and this makes sense as private supplemental coverage under Medigap helps further reduce cost-sharing burdens.

[24] (KFF 2021)
[25] (KFF 2021)

For non-citizens, asset levels, insurance type, being a woman, being African American, and the number of visits to a healthcare provider have no statistically significant impact on the probability of heaving medical debt. However, being uninsured as a non-citizen is associated with a nearly 70% reduction in likelihood of incurring medical debt, and this further strengthens the idea that one, non-citizens tend to be uninsured, and two, the uninsured don't utilize the healthcare system as much.

According to the African American model, having private insurance, receiving government transfers, and being more educated have no statistically significant impact on the probability of a black individual incurring medical debt. Additionally, being black and a woman is associated with an additional 34.8% increase in likelihood of catastrophic healthcare expenditure. These are alarming findings, because it indicates a clear failure on the part of the U.S. healthcare system to both financially protect African Americans and ensure healthcare equity at the intersection of race and gender. Using model 3 as a base model I interacted race with private insurance coverage to better understand the difference that private insurance has between black individuals and non-black individuals. This interaction confirmed the findings of the African American model and **Figure 4** displays the results of this interaction.

Figure 4.



Back in model 3, being black was associated with a 65.9% increase in the probability of incurring medical debt and possible explanation of this is through the education/credit card debt variable. African Americans could be the victims of predatory inclusion in the student borrowing market, meaning that they are approved to borrow to go to college but under exploitative conditions which eliminate the benefits of receiving said education. This is a trend noted by Seamster and Charron-Chenier (2017) which found that "Predatory inclusion... is one of the mechanisms behind the persistence if racial inequality in contemporary markets."[26] To explore

[26] (Seamster and Charron-Chenier 2017)

this idea further I interacted race with debt and educational attainment using model 3 as a base model. **Figures 5** and **6** graph the results of these interactions.

Figure 5.

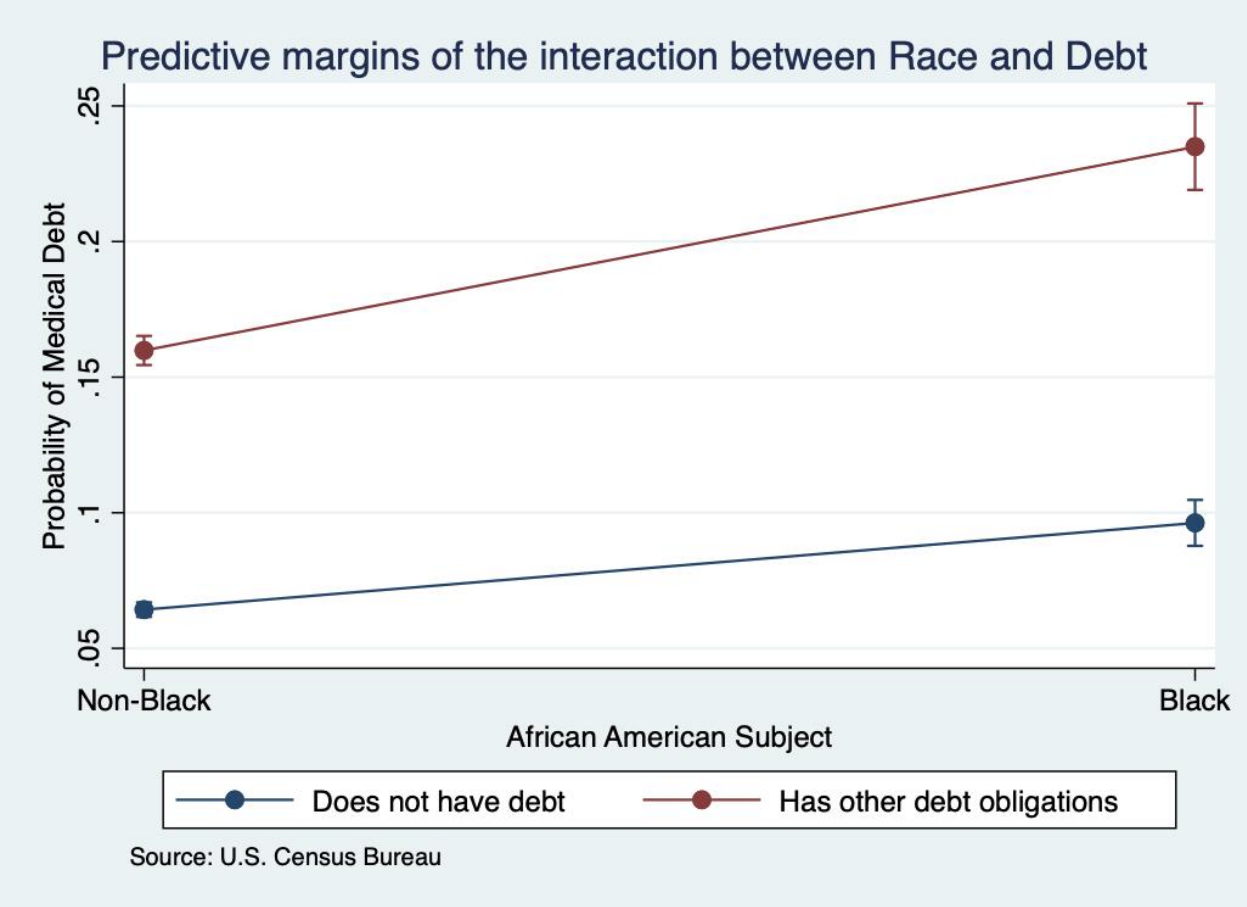
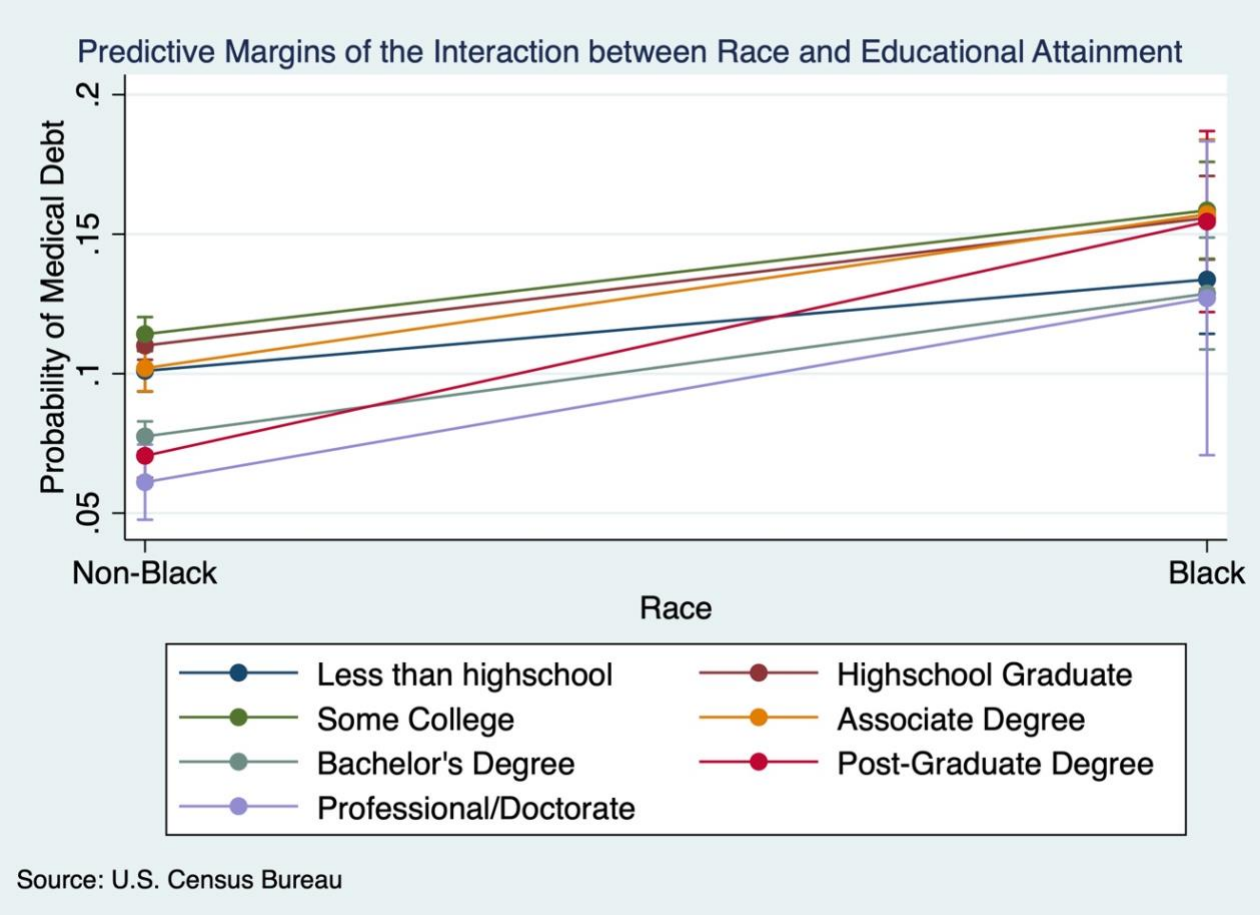


Figure 6.



I include educational attainment in my catastrophic healthcare models because presumably, the more educated a person the more likely it would be that they would have access to better health insurance coverage, either through their jobs or through more disposable income. Holding all else things equal if an African American who holds a Ph.D. has the same likelihood of incurring medical debt as an African American who never finished high school, that could be an indicator that the benefits of higher education are not actually being obtained by African Americans. The interaction between race and educational attainment estimated that for all educational levels, an African American in debt was significantly more likely to have medical debt, with the highest likelihood being post-graduates with an estimated increase of 377% in

probability of incurring catastrophic healthcare expenditures. The impacts my models have estimated for African Americans may be further evidence African Americans are the victims of predatory inclusion.

Regarding impoverishing healthcare expenditure, approximately 43% of U.S. household's incomes are below the poverty line once healthcare expenditure is considered, and this is displayed in **table 4.** This is an extremely high percentage of U.S. households and highlights that the U.S. healthcare system has a severe cost containment issue. Also displayed in **table 4** are rates of impoverishing healthcare expenditure for subsections of the U.S. population. Households with a disabled member, Medicare households, privately insured households, and households in debt have higher than average rates of impoverishing healthcare expenditure. African American households, Medicaid households, and non-citizen households have lower than average rates of impoverishing healthcare expenditure.

Table 4.

Group	Impoverishing healthcare expenditure rate
U.S Non-institutionalized population	42.64%
African American Household	32.36%
Household with at least one disabled individual	48.72%
Medicaid Household	36.04%
Medicare Household	46.75%
Private Insurance Household	44.89%
Non-citizen Household	28.41%
Household in debt	46.06%

As with the catastrophic expenditure analysis, I conduct four impoverishing medical expenditure means comparison hypothesis tests. These two-sided tests compare the rates of impoverishing medical expenditure between the Medicaid and non-Medicaid populations, the disabled and non-disabled, U.S. citizens vs non-citizens, and African Americans to non-African Americans. The null hypothesis in each test is that the difference in means is equal to zero, the alternative hypothesis is that these differences are not equal to zero, and the rejection threshold is set at the 5%. In each test the null hypothesis was rejected at the 1% level.

Column 2 in **table 5** display the odds ratios of my first model for impoverishing medical expenditure, and this model predicts a baseline probability of 42.43% of incurring impoverishing medical expenditure. An additional $10,000 in household wealth is associated with a 1.2% decrease in likelihood of impoverishing medical expenditure. Being in a Medicaid household decreases likelihood by 39.7% while being in a Medicare household or a privately insured household increases likelihood by 17.2% and 49.8% respectively. For every additional month a household member is insured likelihood decreases on average by 14.7%, while increased utilization through an additional night spent in the hospital or provider visits increases likelihood 0.6% and 2.0% respectively. Lastly, having a disabled household member increases the likelihood of incurring impoverishing medical expenditure by 53.2%. All estimates for model 1 are statistically significant at the 0.1% level, except for the average number of months household members were insured which was significant at the 5% level.

Column 3 in **table 5** display the odds ratios of my final model for impoverishing medical expenditure, and this model predicts a baseline probability of 26.54% of incurring impoverishing medical expenditure. The effects of the explanatory variables included in the first model largely hold apart from being a member of a Medicare household, whose impact is no longer statistically

significant in the second model. Increases in household educational attainment, the number of women in a household, and being a citizen all are associated with increases in the likelihood of incurring impoverishing medical expenditure. (1.7%, 1.7%, and 39.7% respectively) Being in an African American household decreases one's likelihood of impoverishing medical expenditure but this effect is not statistically significant. Lastly, as in the catastrophic models, a household which is already servicing prior debt is 24.3% more likely to be impoverished by their medical expenditures. The inclusion of these demographic variables in the second model barely improves on the first model as model 2's pseudo R^2 is only 0.58% larger than the model 1's. **Figures 7** and **8** display predictive margins of household wealth and provider visits in relation to the probability of experiencing impoverishing medical expenditure.

TABLE 5.

Impoverishing healthcare expenditure	MODEL 1. **(PSEUDO R^2= 4.30%)**	MODEL 2. **(PSEUDO R^2= 4.88%)**
Household Wealth	.0998*** (-4.60)	0.998*** (-4.57)
Medicaid Household	0.603*** (-15.37)	0.599*** (-14.79)
Medicare Household	1.172*** (5.54)	1.228*** (7.00)
Private Insurance	1.498*** (11.49)	1.364*** (8.52)
Average number of months Insured	0.853* (-2.49)	0.853* (-2.45)
Hospital Stays	1.006*** (3.48)	1.006*** (3.75)
Doctor Visits	1.020*** (21.65)	1.018*** (19.48)
Disability	1.532*** (14.85)	1.544*** (14.92)
Educational Attainment		1.017* (2.10)
African American		0.670*** (-9.89)

Women		1.017**** (4.45)
Citizen		1.397** (3.12)
Debt		1.243*** (8.24)
Constant *(Baseline odds)*	42.43%	26.54%
	t statistics in parentheses	* p<0.05, ** p<0.01, *** p<0.001

Figure 7.

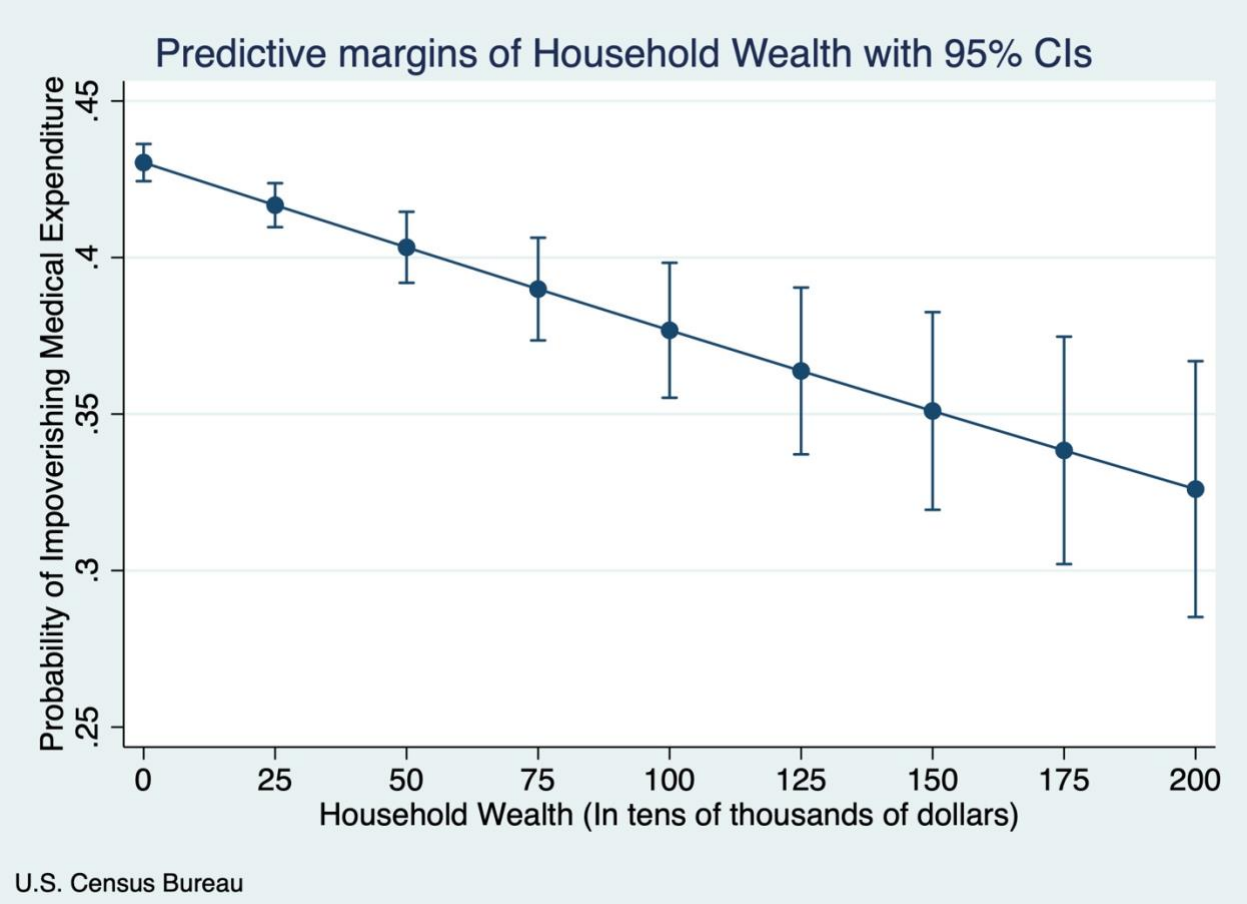
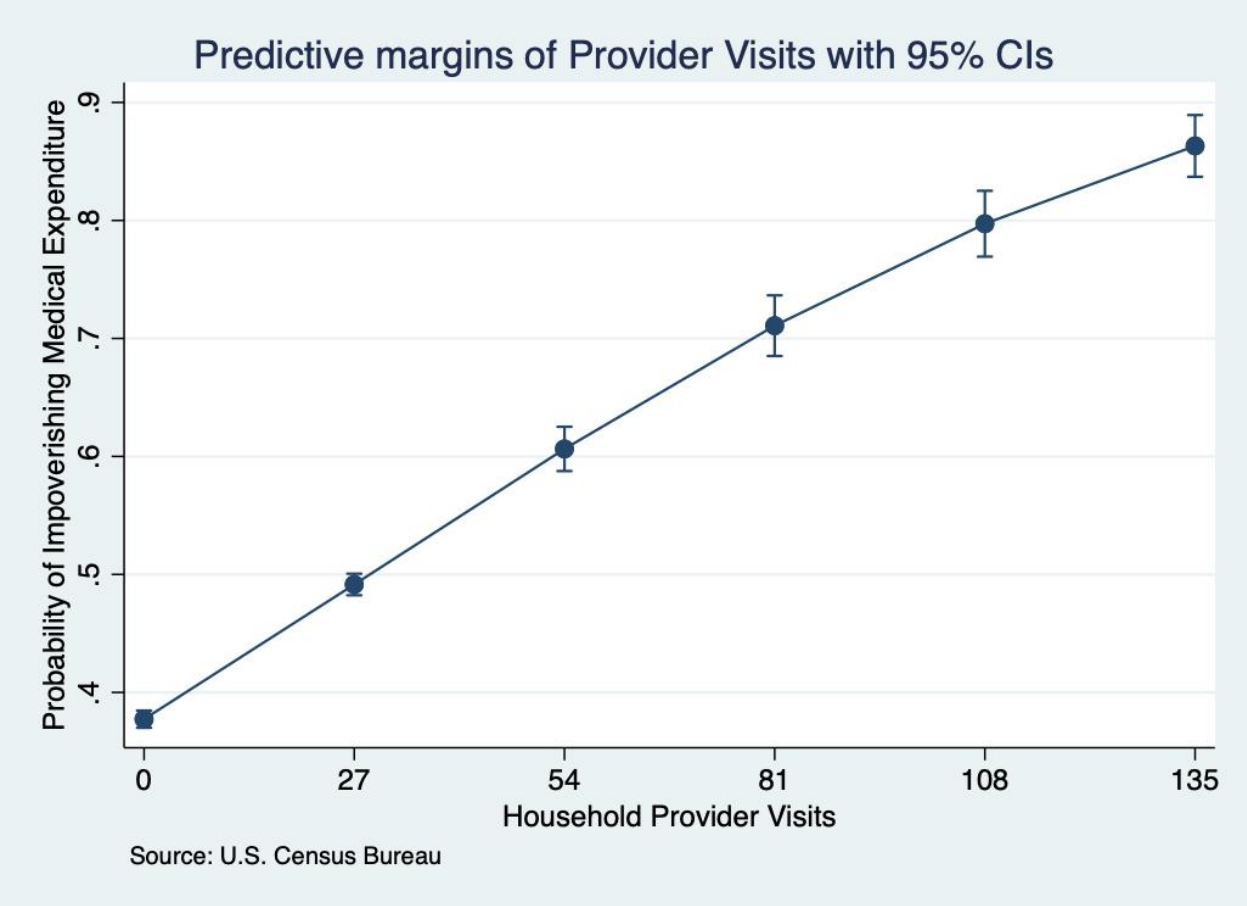


Figure 8.



Unsurprisingly, **Figure 7** shows that ability to pay is a function of household's wealth, however even at high levels of wealth my models predict there is still a relatively high likelihood of experiencing impoverishing medical expenditure. If even wealthy households can experience impoverishing medical expenditure, this could indicate that the U.S. healthcare system does an extremely poor job at cost containment and financial protection. **Figure 8** confirms what previous literature and my catastrophic models already found, which is that increased utilization of the U.S. healthcare system increases the likelihood of an adverse financial outcome. However, increased utilization seems to matter a lot more for impoverishing outcomes as households with very high utilization rates, likely those who have members with chronic conditions or

disabilities, are estimated to have nearly a 100% probability of experiencing impoverishing healthcare expenditure.

My hypothesis that public insurance schemes are preferable to private insurance schemes holds for both impoverishing and catastrophic medical expenditures. Being in a Medicare household increases likelihood in my impoverishing models, but to a lesser extent than being in a privately insured household. Additionally, because Medicare households are more likely to be on fixed incomes as Medicare recipients are at retirement age it would make sense that these households whose annual incomes are low by design are susceptible to impoverishing expenditures. The pronounced effect that prior debt obligations had in my catastrophic models has been weakened severely in my impoverishing model which makes sense because there are income benefits of taking on student loan debt, it's the servicing of that debt with high interest rates that gets individuals into trouble in the catastrophic models. Lastly, African Americans are estimated to be less likely to experience impoverishing medical expenditure, which is a surprising finding given the previous finding that being African American increases the probability of experiencing catastrophic expenditure considerably. Further research should be conducted to explore why there is this disconnect between the effect of being black and the likelihoods these two types of expenditures.

5.Conclusion

In conclusion, the U.S. healthcare system leaves a lot to be desired regarding the financial protection of its users. 10% of the U.S. population experienced catastrophic healthcare expenditure and nearly half of the U.S. population experienced impoverishing healthcare expenditure during the timeframe of 2017-2019. Building on the literature I find evidence that utilization, insurance status, health status, and household/individual socioeconomic status matter

a great deal in understanding the incidence of both types of expenditures. Additionally, certain demographics of the U.S. population are more susceptible to these expenditures than their counterparts, most notably women, the disabled, those with chronic conditions, and citizens have both higher incidence rates and likelihoods for these expenditures. African Americans are extremely susceptible to catastrophic healthcare expenditure but are not as likely to experience impoverishing healthcare expenditure. This be the result of the difference in the ways that these two types of expenditures are incurred, difference in utilization rates of African Americans, or other factors, but further research should be conducted on the intersection of race and healthcare expenditures.

My research finds a lot of interesting discoveries but there are limitations to my analysis. Firstly, because the data I use are three different pooled samples within the reference period and the annual approach I took to my analysis, it is hard to quantify the extent to which consumption patterns are negatively impacted. It may be worth further analyzing healthcare expenditures impact on consumption by tracking the same individuals and households over an extended period longer than a year. Additionally, my definitions of catastrophic and impoverishing healthcare expenditures are admittedly broader than how other researchers and institutions have traditionally defined these terms. As a result, the mechanisms of these expenditures and the areas in which households and individuals choose to cut back consumption because of these expenditures should be further explored. My definition of impoverishing expenditure is income level based rather than consumption-based definition which the World Health organization's uses. This definition difference and the fact that the Census Bureau accounts to multiple factors which may lead to a household's income being negative during the year may explain why I find such high incidence rates of impoverishing expenditure in the United States. Lastly, regarding

the creation and tracking of households in this survey I do not account for changing composition of households from month to month, and this may have impacted the results of my impoverishing analysis.

U.S. healthcare is generally good quality for those who have both the access and the means, and my analysis suggests that the policymakers in the U.S. need to both achieve universal health insurance coverage and improve the healthcare systems ability to financially protect individuals. There are a lot of policy ideas on how to achieve universal or near-universal coverage, but one way this could achieved is by automatically enrolling uninsured Americans into either a fully or partially subsidized private or public option healthcare plan with reduced to no cost sharing requirements.[27] Another notable way this could be done that is by instituting a single payer healthcare system with cost sharing waivers for low- and middle-income populations.[28] The World Health Organization recommends that nations pursue a number of policies in order to strengthen their country's healthcare systems financial protection and the policymakers in the U.S. should take recommendations into account in any future healthcare reform. These policies include increasing public spending on healthcare, eliminating large gaps in health coverage, ensuring out-of-pocket payments account for less than 15% of total expenditure on healthcare, and design public and private insurance plans to minimize access barriers and reduce cost sharing requirements, especially for low-income individuals and households.[29] Overall, financial protection is severely lacking in the United States healthcare system and is influenced by many health related and demographic factors. Researchers should

[27] (Congressional Budget Office 2020)
[28] (Congressional Budget Office 2020)
[29] (Thomson, Cylus, and Evetovits 2019)

continue to study the trends I find in my analysis, and it is essential for policymakers to reform the U.S. healthcare system.

6.Appendix

Figure 2.

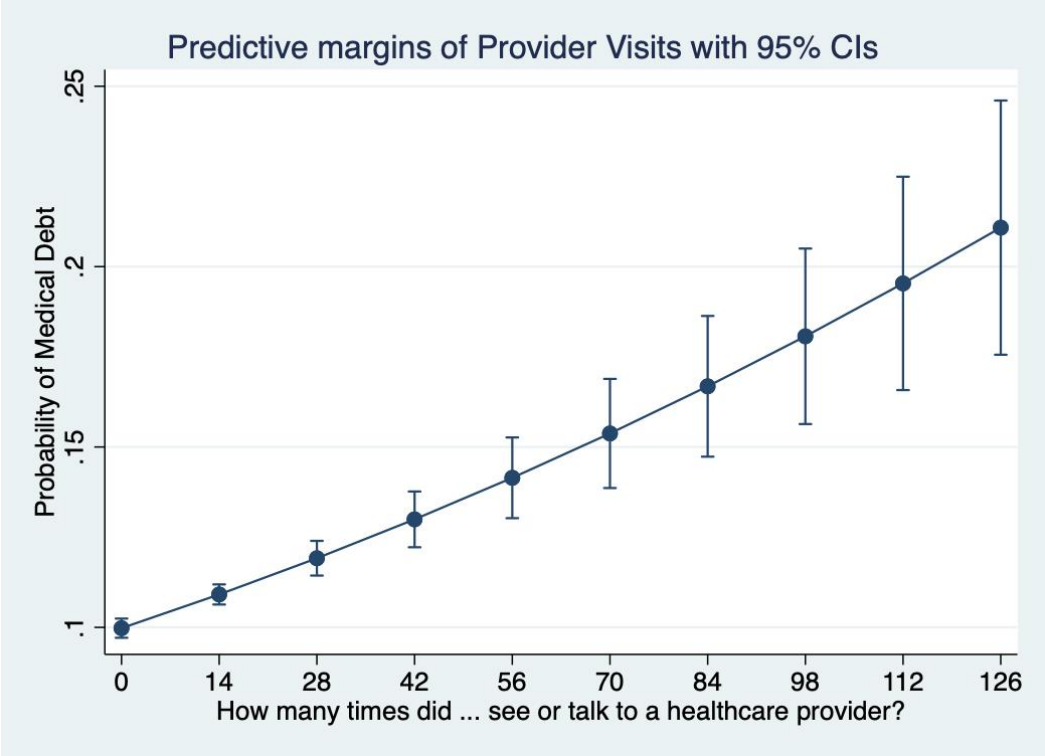


Figure 3.

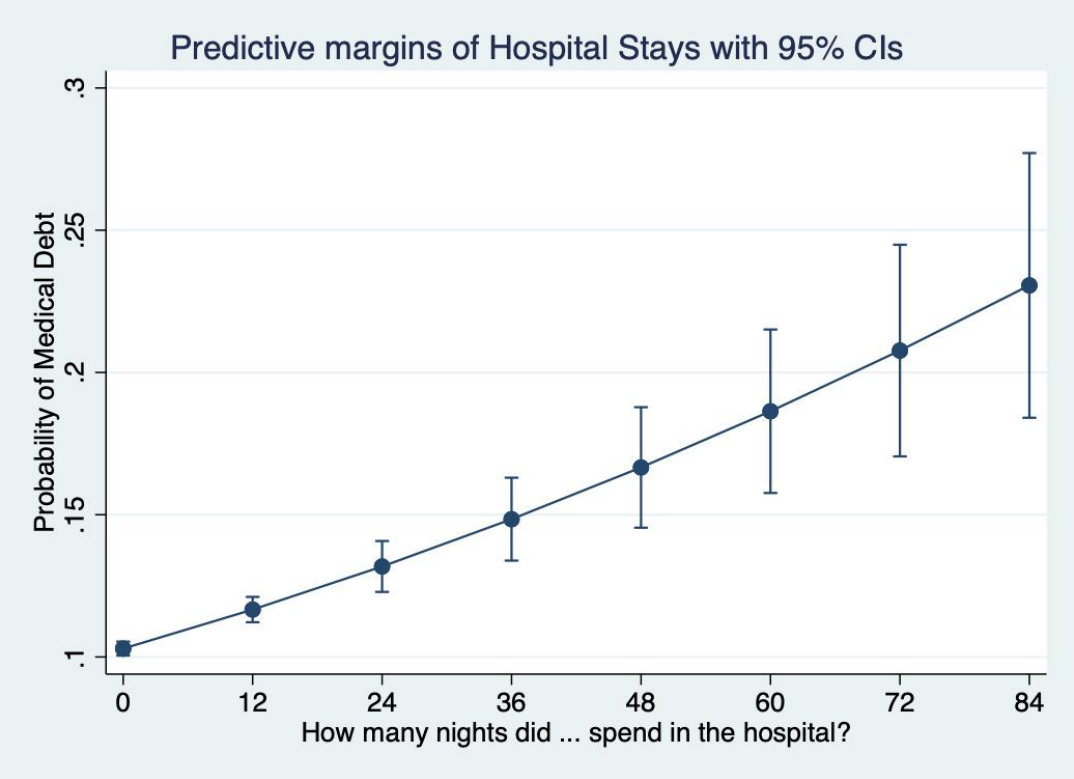


Table 3.

Catastrophic Healthcare Expenditure	***Sex Model*** *(Pseudo R^2=12.88%)*	***Black Model*** *(Pseudo R^2=11.83%)*	***Citizen Model*** *(Pseudo R^2=9.98%)*	***Medicare Model*** *(Pseudo R^2=13.68%)*
Annual Out-of-Pocket Expenditure	1.012*** (13.64)	1.012*** (4.62)	1.013*** (4.80)	1.011*** (9.25)
Annual Family Income	0.955*** (-9.73)	0.931*** (-6.33)	0.937** (-3.00)	0.951*** (-5.37)
Assets	0.974*** (-6.28)	0.985** (-2.61)	1.002 (0.62)	0.989*** (-3.29)
Yearly Insurance	0.905*** (6.87)	0.935* (-2.47)	0.915* (-2.11)	0.876*** (-3.30)
Uninsured	0.370*** (-5.62)	0.449* (-2.43)	0.308* (-2.39)	
Doctor Visits	1.008*** (5.80)	1.011*** (3.71)	0.995 (-0.52)	1.008*** (4.96)
Hospital Stays	1.014*** (5.46)	1.011* (2.36)	1.039** (2.57)	1.014*** (5.73)
Disability	1.665***	1.864***	1.715**	1.872***

	(10.45)	(6.59)	(2.84)	(8.06)
Health Status	1.441***	1.477***	1.293***	1.397***
	(17.65)	(9.92)	(3.51)	(10.97)
Government Transfers	0.818***	0.986	0.771	0.989
	(-5.22)	(-0.24)	(-1.07)	(-0.30)
Public Insurance	0.563***	0.407***	0.582	
	(-8.36)	(-6.85)	(-1.55)	
Private Insurance	0.812***	0.906	1.013	0.641***
	(-3.44)	(-0.86)	(0.04)	(-7.51)
Educational Attainment	0.932***	0.987	0.879**	0.914***
	(-5.28)	(-0.50)	(-2.77)	(-4.54)
Citizenship	1.450***	1.882*		1.328
	(3.81)	(2.39)		(1.13)
African American	1.698***		1.092	1.862***
	(10.37)		(0.32)	(8.40)
Woman		1.348***	1.265	1.242***
		(3.88)	(1.64)	(3.63)
Debt	2.981***	2.851***	3.024***	2.841***
	(26.88)	(12.98)	(7.57)	(18.03)
Constant (Baseline odds)	10.91%	6.01%	12.38%	7.31%

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